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# MOBILITY, KNOWLEDGE AND COOPERATION: SCIENTIFIC DIASPORAS AS AGENTS OF DEVELOPMENT

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**Summary**

The growing knowledge gap between the North and the South shows the need for innovative perspectives in the study of the mobility of scientists and skilled professionals. Today, more than ever, it is obvious that there is a need to recognize the importance of science and the production of knowledge for development, the value of international cooperation and the intervention of scientific diasporas as relevant actors. As globalization and technological advances have promoted new ways of contributing *from a distance,* the challenge now is to find the best way to involve emigrated human capital in the scientific and socioeconomic progress of developing countries. This article offers an evidence-based analysis of the transnational practices of scientists and skilled professionals from Colombia, India and South Africa living in Switzerland, and it examines the conditions and the opportunity structures that are necessary if they are to act as agents of change in the benefit of their countries of origin.

**Keywords:** Scientific diasporas, scientific mobility, knowledge communities, international cooperation, development.

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## INTRODUCTION

The growing international mobility of scientists and skilled professionals is a particular phenomenon of globalization. It leads to major concerns when it is considered as a loss for the developing countries of origin, whose bank of human capital is limited, and as a gain only for the rich countries of destination. Recent estimates show that the volume of skilled personnel from third countries living in the countries of the OECD increased by 8 million between 1990 and 2000, reaching a total of 20 million by the end of the millennium (Katseli, Lucas and Xenogiani, 2006). Docquier and Marfouk (2005) calculate that 90% of the world's skilled migrants live in OECD countries.

Over the last few decades, new ideas on the determinants of the international mobility of human capital, its various manifestations, and the problems concerning its definition have guided a variety of study approaches and possible lines of action. At both an academic level and in the design of policies, we have had several definitions as well as diverse and conflicting perspectives of this *wicked problem* (Logue, 2009), which is related to the very tension of the *brain drain - brain gain* discussion. This tension, as Caloz-Tschopp mentions (2010), is part of the nature of exchange and unequal relationships of power, not only in terms of the circulation of knowledge but also in terms of its production, appropriation and use. This tension, she say, "defines the cognitive capital produced by human beings, who are linked to the new systems, tools, technologies, institutions, countries and networks that shape our present day globalization" (p. 26).

Traditionally, scientists and skilled professionals have been guided by the universal nature of science and attracted by professional opportunities and the *tangible capital* that offers them access to available resources, equipment or infrastructure (David and Foray, 2002). However, this mobility is increasingly influenced by major global transformations, world competition for talent and immigration policies, the internationalization of higher education, as well as the transformation of countries into knowledge-based economies. All this has resulted in the flows of human capital, ideas and knowledge becoming more

complex and multidirectional, and the effects have been diversified. In referring to these flows, Caloz-Tschopp (2010) defends the importance of the moral universalism of science, emphasizing that "it is not a simply economic mobility, (and) it can't be confined to a utilitarian vision of the free movement of economic factors in terms of ends and means" (p. 104).

On the other hand, the power of global networks (Castells, 1997) has modified the preponderance of states as the main organizers of collective life and the creators of national identities (Castells, 1996), stimulating the rise of new actors, among which *transnational communities* (Faist, 2000) (Wickramasekara, 2010) have acquired notability, flourishing as new *knowledge communities* (Foray, 2004). Accordingly, the international mobility of human capital offers new dimensions and scientific cooperation opportunities that are of great value for developing countries.

The relevance of knowledge-based activities and economies in the development process (David and Foray, 2002) (Foray, 2004) has contributed to the *scientific diaspora option* (Barré et al., 2003) (Tejada and Bolay, 2010) being increasingly considered as an alternative for approaching the phenomenon of the international mobility of scientists. This option suggests the implementation of strategies that guide the flow of technology, knowledge and other resources of emigrated scientists and skilled professionals for the purpose of generating economic and social transformations in their countries of origin. This vision recognizes that the evolution in technology has changed the production and transmission of information and that participation *from a distance* is possible without the definitive return of human capital being automatically considered as the only reasonable option, as imagined by brain drain theories.

In the 2010 UNESCO Science Report, Hollanders and Soete refer to the seriousness of the exodus of human capital that some developing countries suffer and to the enormous challenges caused by this "loss" for the poorest countries. However, in offering a more promising vision, they also recognize the importance of diasporas "as a useful departure point for the design of policies for more effective technology transfer and knowledge spillovers" (p. 7), either by return to the country of origin or through their participation *from a distance*.

Accordingly, by recognizing that scientists and skilled professionals can remain in touch and have a positive influence in their countries of origin, the focus of the discussion has moved in recent years from brain drain prevention to the possibility of taking advantage of knowledge circulation or brain gain (Meyer and Charum, 1995) (Gaillard and Gaillard, 1999) (Meyer, 2001). We can see the recent efforts that developing countries have made to find innovative ways of collaborating with their scientific diasporas and taking advantage of their resources and networks to strengthen international cooperation, make structural changes and in some way or other mitigate the scientific disparities and the availability of human capital between the North and the South expressed by the gap in world knowledge. These inequalities manifest themselves in different ways. For example, in the aforementioned UNESCO report, Hollanders and Soete (2010) argue that the disparities in the levels of development between the countries and regions of the world are a reflection of the differences in the investment in *intangible capital* (David and Foray, 2002) – investment in human capital as well as in the long-term production and transmission of knowledge. Using data from 2007, they illustrate the contrast in the investment in research and development (R&D), showing that while developed countries invest an average of 2.3% of their GDP, developing countries and less advanced countries invest only 1% and 0.2% respectively. The inequality in the distribution of researchers is also contrasting, with 62.5% of the world's researchers concentrated in developed countries (a total of 3655.8 researchers per million inhabitants / pmh) with only 37.4% in developing countries (580.3 researchers pmh), while the figure is only 0.5% in the less advanced countries (43.4 researchers pmh).

On the other hand, although the acquisition and accumulation of knowledge, investment in R&D and the advancement of higher education and technology are relevant for the development of countries, today the globalization process facilitates the reproduction and diffusion of information in a world in which geographical borders becoming less important for research and innovation, and in which new actors have become relevant. David and Foray (2002) remind us that in the current knowledge-based economies and societies, the need for innovation

has become increasingly stronger because it "comes closer to being the sole means to survive and prosper in highly competitive and globalized economies" (p. 11). Furthermore, the proliferation of new information and communication technologies (ICTs) and with them the increase in the world bank of knowledge symbolized by these technologies, as well as scientific advances, offers developing countries the possibility of reaching greater levels of prosperity and productivity than ever. However, limited access to scientific knowledge and the slow advance of technological innovation in developing countries continue to be causes for concern.

Against this complex backdrop of the challenges and opportunities related to the importance of science and the production of knowledge for progress, we can appreciate the relevance of international cooperation and scientific diasporas as key actors that demand opportunity structures and adequate environments that allow them to act as agents of development.

This article has several aims. First of all, it seeks to promote the focus of the scientific diaspora option in the study of the link between migration and development; secondly, it sets out to explore the theoretical and conceptual implications; and thirdly, it attempts to provide an evidence-based analysis of the experiences and transnational practices of scientists and skilled professionals from Colombia, India and South Africa in Switzerland[1].

1. The project "A Swiss network of scientific diasporas to enforce the role of highly skilled migrants as partners in development" was carried out by the Cooperation & Development Centre (CODEV) of the École Polytechnique Fédérale de Lausanne (EPFL) in collaboration with the International Labour Organization (ILO), the University of Geneva, the Swiss Forum for the Study of Migrations and Population (SFM) and the University of Lausanne, with financial support from the Geneva International Academic Network (GIAN).

## CONCEPTUAL QUESTIONS IN THE DEFINITION OF SCIENTIFIC DIASPORAS AND THEIR TRANSNATIONAL PRACTICES

Within a context dominated by knowledge-based economies, the international mobility of human capital has provided academic studies and political discussion with fundamental concepts and concerns within the areas of migration and development where the challenges in the production and international circulation of knowledge and the motivation to promote scientific cooperation (especially on a North-South basis) reappear and capture the attention of this article. Central among these is the concept of *scientific diasporas.*

The term *diaspora*, historically associated with the notion of the dispersion of an ethnic population outside its country of origin (Cohen, 1997) (Sheffer, 1986), has evolved and has been the subject of various interpretations over time, and today it is associated with the notion of *transnational communities* (Faist, 2000) (Wickramasekara, 2010). Both concepts, diasporas and transnational communities, are based on a process - and on activities related to it - that transcend borders. This process is known as *transnationalism.* As a perspective, transnationalism considers migrants not as individuals who have been uprooted from their country of origin, but rather as new autonomous actors (Castells, 1997) who develop and maintain links across borders (Vertovec, 1999, 2004) (Glick Schiller et al., 1999) and who have their own identity and who feel a sense of belonging to several places at the same time. The element of limited spatiality and scope is important here: unlike global processes which take place within a wider world context, transnational processes are anchored in a determined space which encompasses two or more national states and they involve actors from the state as well as from civil society.

The study of transnationalism in migration, which is mainly concerned with transnational actors, has evolved towards a new perspective which provides greater evidence of the experiences of migrants in the country of destination and the interdependence with the country of origin (Faist, 2000, 2010). *Transnational practices* (Faist, 2000) or *social remittances* (Levitt, 1999) refer to the circulation of ideas,

symbols, cultural material, social capital and other valuable resources that flow from the countries of destination to the countries of origin through initiatives that link migrants to their communities of origin. During the operation of the transnational dynamics, reciprocal links are established and these are essential in terms of creating a bi-directional influence and promoting cooperation. Within this process, globalization and information and communication technologies have certainly caused transnational interactions to move from being spontaneous initiatives to more structured and systematized practices (Tejada, 2010). In this respect, following Faist (2000), in order to be able to speak about transnational communities there is a need for a situation in which the reciprocal exchanges are made through dense and strong social and symbolic links through space and over time between those who left and those who remain in the country of origin. These exchanges are characterized by creating a "stable equilibria with social and symbolic equidistance to the former emigration country and to the country of settlement" (Faist, 2000: 261).

Some authors such as Cohen (1997) and Sheffer (1986) emphasize the capacity of diasporas to make valuable and creative contributions to the country of origin and to the country of destination at the same time. For their part, Bordes-Benayoun and Schnapper (2006) identify two elements that unite diasporas: 1) a common ethnic identity; and 2) a collective relationship of solidarity towards their country of origin.

It is important to point out that in considering diasporas as owners of a collective identity (Faist, 2010); their transnational practices must be understood as the result of community actions. Furthermore, since they exist and operate as *communities without borders* (Basch et al., 1994) but with a common identity, diasporas are autonomous actors that meet "outside the state but within the nation" (Caloz-Tschopp, 2010). In this respect and following the approach proposed by Butler (2001), diasporas consist of communities established in various places outside the country of origin and which maintain a certain degree of political and economic autonomy as a group in the host country, while they create networks and links, not only with the country of origin but also with other co-nationals in other parts of the world.

Today, knowledge is acquiring ever-increasing levels of power in the economy and in the societies in which new organizations and transnational communities have expanded. These organizations are explicitly devoted to the production and reproduction of knowledge through decentralized cooperation procedures (Foray, 2004) and the intensive use of ICTs. Foray's concept of *knowledge communities* (2004) is useful in this context insofar as it refers to networks of individuals who make an effort to produce and circulate new knowledge and whose forms of organization and functions have acquired a particular importance. An example of this is the case of scientific communities and networks whose value as an innovative way of generating ideas and circulating know-how in today's society of knowledge is becoming increasingly significant.

We have another notable example in *scientific diasporas* (Barré et al., 2003) or *knowledge diasporas* (Kuznetsov, 2006), which refer to groups of emigrant scientists, engineers and skilled professionals who organize themselves in order to create cooperation opportunities with the aim of impacting the socioeconomic development of their countries of origin, particularly in areas related to science, technology and education. Here, the element of solidarity, which involves the community of scientists and skilled professionals, is relevant and it is pronounced through their participation in organizations or associations through which they usually express and reinforce their identity as a transnational group, thereby facilitating the collective influence in the country of origin. When the members of the knowledge communities mobilize themselves in a group and develop their skills together, they facilitate the collective influence in the country of origin and become agents of change (Foray, 2004) (Tejada and Bolay, 2010).

## SCIENTIFIC DIASPORAS AS KNOWLEDGE COMMUNITIES

Recognizing the importance of the *community* as an organizational system that allows the exploitation of the benefits of knowledge (Foray, 2004), it is argued here that scientific diasporas, as *knowledge communities*, seek above all to produce new knowledge and to circulate it to the benefit of their countries of origin. Scientific diasporas are promoters of research.

Scientists, as the main members of these diasporas, produce knowledge to satisfy their curiosity as researchers, but they also do so because they are motivated by the chance to be able to offer solutions to the relevant questions of the reality in which they live.

To understand the way in which scientific diasporas develop their mobilization capacity and establish community initiatives to reach their objectives, we propose taking the concept of knowledge communities and their fundamental components proposed by Foray (2004) as our basis. The author suggests an approach based on *knowledge openness* systems, which can be understood as those where the principles of rapid disclosure of new knowledge are predominant and in which a number of procedures facilitate and reinforce the circulation of this knowledge as well as the circulation of the research tools. Considering, as Foray (2004) points out, that these systems "are related to public or semi-public spaces in which knowledge circulates" (p. 165), it is understood that knowledge communities are oriented towards the production and reproduction of knowledge through decentralized cooperation processes. Accordingly, Foray recognizes the importance of the community "as an organizational system allowing the exploitation of the virtuous proprieties of knowledge" (p. 182). The ICTs increase the power of the production and circulation of knowledge both individually and collectively, and they facilitate the processes related to the emergence of these new organizations. These technologies provide powerful opportunities for collective action by allowing information to be shared among large numbers of people and, Foray says (2004) "they are the right tools for the creation and expansion of virtual communities" (p.30).

In analyzing these processes, Foray identifies four key elements which he considers to be the main characteristics of knowledge communities:

- Multiple capacities for the creation and reproduction of knowledge;
- Mechanisms that foster the creation of public or collective spaces for the exchange and circulation of knowledge,
- Suitable norms and instruments to establish trust,
- The intensive use of ICTs as tools for the invention, codification and collective transmission of knowledge.

In order to be able to identify the determinants and conditions that are necessary for the collective influence of scientific diasporas as knowledge communities with regard to working and promoting the circulation of knowledge, we will now try to apply this theoretical framework to the study of scientists and skilled professionals from Colombia, India and South Africa in Switzerland.

## EVIDENCE ON THE SCIENTIFIC DIASPORAS OF DEVELOPING COUNTRIES IN SWITZERLAND

### *Methodology*

This study gave priority to the research of primary information. In order to collect this information, semi-structured in-depth interviews of a qualitative nature were held with scientists and skilled professionals from Colombia, India and South Africa in several Swiss cities[2]. The sample included human resources in science and technology[3] and it systematically ensured the representation of professionals and scientists who are active in different sectors and disciplines, from different socioeconomic backgrounds and age groups and with differences in the duration of their stay. A total of 76 interviews were held and these were divided into three groups: (1) scientists, doctoral students and postdoctoral researchers; (2) personnel in international organizations; and (3) managers, directors and consultants from the private sector.

In the study we looked at their experiences and perceptions in relation to three areas:

- The reasons for emigrating, migratory routes and living and professional conditions in Switzerland;
- The links that they maintain with their country of origin and the transnational practices implemented; and

2. Mainly in Lausanne and Geneva, and also to a lesser extent in Bern, Zurich and Basel.
3. Following the definition of the concept of *highly skilled* personnel proposed by the OECD in the Canberra Manual (1995).

- Policies and suitable environments that facilitate these practices, and the obstacles and unfavourable environments that limit them.

*Switzerland as a country of destination*

The reputation for scientific and academic excellence of the Swiss institutions that are at the vanguard of technological progress and innovation is one of the main elements of attraction. In addition, the high quality of life together with a thriving international labour market within the area of international organizations and the presence of prestigious transnational companies make this country an attractive destination for students, scientists and skilled professionals.

A recent study showed that labour market conditions in Switzerland for the immigrant population are favourable and immigrants integrate well in the Swiss labour market as 3/4 of the total are employed, a figure that puts this country in first position among OECD members (Liebig et al., 2012). However, we need to examine this information more carefully as the same study mentions that the high levels of employment are associated with a significant level of over-qualification among emigrants with academic credentials from countries outside the OECD, as many of them cannot access jobs that are in line with their capacities and their level of studies.

For a long time, Switzerland has been a country with a high rate of immigration. With a foreign work force of 27%, it is one of the OECD countries that depends most on immigrant workers (Liebig et al., 2012) and one of the European countries with the highest proportion of foreigners. We can see that the migratory policy and the impact of the foreign work force in the economy have systematically been relevant themes in the public debate (Becker et al., 2008) (Riaño and Wastl-Walter, 2006) (Kaya, 2005).

Over the past few years, the composition of immigration in Switzerland has undergone important changes which are the result of the current dynamic of globalization and international labour mobility, as well as the tendency of countries to transform themselves into in knowledge-based economies. These phenomena are combined with the

current policy of free mobility between Switzerland and the countries of the European Union (EU) as well as with Swiss laws of foreigners, which have become increasingly selective by considering immigrants in different ways, according to their level of qualifications and their national origin[4]. This has resulted in the nature of current migratory flows bringing an increasingly more skilled labour force (Pecoraro and Fibbi, 2010) (Becker et al., 2008) especially highlighting the greater presence of skilled professionals from the countries of the EU. It should be pointed out that more than 60% of all immigrants in Switzerland come from the developed countries of the OECD and more than half come from the neighbouring countries with which Switzerland share national languages (Liebig et al., 2012). In fact, following the gradual introduction of the freedom of movement with the countries of the EU, Switzerland has recently experienced high levels of immigration, and 5% of the resident population now consists of immigrants who have been resident for less than 5 years (Liebig et al., 2012), most of whom come from neighbouring countries.

In addition to the labour market flows, an interesting component of international mobility that impacts directly on Switzerland is the academic flow that attracts students to this country. Switzerland is a recognized destination for international students (OECD, 2010), most of whom are registered on advanced research programs[5]. In recent years this country has seen a significant increase in the presence of foreign students, reflecting the world trend of both the internationalization of higher education and the increasing mobility of students since the beginning of this century (UNESCO, 2006).

4. Specifically, selective Swiss migratory policies of the three circles model introduced in 1991 and the two circles model which replaced the former in 1998 has resulted in a significant increase in skilled immigration over the last few years (Becker et al., 2008).
5. According to data from the OECD, international students in OECD countries are registering more and more on advanced research programs than on regular university programs. In Switzerland, more than 40% of those registered on advanced research programs are international students, a percentage that can only be compared to that of the United Kingdom (38.6%). In fact, international students represented 12.7% of all those registered for third level education programs in Switzerland in 2004, while 42.5% of all those registered on advanced research programs were international students in the same year (OECD, 2007).

The international mobility of students (Kuptsch and Pang, 2006) is relevant when, as *probationary immigration* (Kuptsch, 2006) it is usually a forerunner to labour migration and stimulates the transformation of students into qualified workers. In this regard and following the example of other European countries, in recent years Switzerland has opened up the discussion on the need for policies to attract international students who increasingly operate as a tool in the international competition for qualified personnel (Tejada et al., 2011). Accordingly, we can observe advances in the implementation of policies that allow international students to enter the Swiss labour market once they have finished their studies.

## COLOMBIA, INDIA AND SOUTH AFRICA AS THREE CASE STUDIES

Historical factors determined the selection of Colombia, India and South Africa as case studies, as these three countries have been pioneers in the implementation of new *brain gain* initiatives that capitalize the resources of their diasporas by taking advantage of the dynamism of the emigrated skilled personnel who wished to benefit their country of origin through both individual ambitions and collective actions.

It is a recognized fact that the scientific diasporas of these three countries have created dynamic forms and innovative creative cooperation projects with their countries of origin. Colombia (Meyer, 2001) (Tejada, 2010) and South Africa (Brown, 2003) were pioneers in the creation of scientific diaspora networks making use of information and communication technologies to implement a form of organization and decentralized collective action as a means of strengthening the science and technology sectors through institutional support and intervention. The Caldas Network of Colombia and the South African SANSA (South African Network of Skills Abroad) were examples of this. For its part, India's involvement in the world technological competition was facilitated by skilled emigrant professionals who mobilized their co-nationals at the end of the 1990s to form associations and networks in the Silicon Valley region of the United States, thus creating a corridor of investment, technology and knowledge through initiatives from a distance (Saxenian, 2006) (Khadria, 2004).

On the other hand, two of the three case studies, India and South Africa, also stand out because the immigrants of these two countries in Switzerland are usually highly qualified. The case of India is paradigmatic as the percentage of skilled personnel out of the total number of immigrants from this country in Switzerland is very high (79.5%), and this percentage has tended to increase over the years. The same situation can be observed for South Africa: 73.1% of all South Africans in Switzerland are skilled human capital.[6] Returning to the case of India, 80% of all the nationals of third countries who entered Switzerland in 2008 had higher education according to a report of the Swiss Federal Office for Migration (OFSM), with the most numerous group among them being nationals from India who mostly consisted of specialists in the information technologies sector.[7] Although the mobility of students and scientists from India to Switzerland is on the increase, we can see that their stay in Switzerland is mostly of a temporary nature. In fact, almost half of all Indian nationals with higher education stay in Switzerland for at least five years (Tejada et al., 2011).

Furthermore, Switzerland maintains systematic scientific collaborations with the three countries. Specifically, it maintains an institutionalized bilateral *top-down* scientific dialogue with India and South Africa within the framework of the current Swiss bilateral scientific cooperation strategy.[8] In Colombia it is backed by more than 20 years of cooperation projects, which were started on a *bottom-up* basis for the most part by Colombian scientists established in Swiss academic and research institutions.

6. Based on data from the Swiss Population Census 2000.
7. *Migration Report 2009*, Federal Office for Migration, Swiss Confederation.
8. For the 2009-2012 phase, India and South Africa form part of the group of priority countries for bilateral scientific collaboration with Switzerland, together with China, Russia, Japan, South Korea, Chile and Brazil.

*Routes and determinants of mobility*

Recognizing that the world of science benefits from international mobility and from the nomadism of the scientists, it is hardly surprising to learn that the migratory paths of the scientists and skilled personnel from Colombia, India and South Africa include several intermediate stop-off points before they arrive in Switzerland. Most of these stop-offs are in countries with a scientific tradition in North America and Europe. One Colombian scientist mentioned that exposure to the international scene *"is basic for scientific and professional advancement, as well as for the development of capacities in Colombia"*. We see that most doctorate students from the three countries arrived directly in Switzerland without making any intermediate stops. For many of them, the stay in this first destination serve as a trampoline to access new scientist and academic destinations in other countries after the completion of their studies, while others try to enter the Swiss labour market.

We can identify a mixture of reasons for leaving the country of origin. These are related to professional aspirations and the desire to advance professionally within internationally recognized academic and scientific environments, work opportunities and professional relocation possibilities, the attraction of higher salaries, the desire for training and academic advancement and opportunities for a better lifestyle. This is reflected in the words of two of the scientists who were interviewed: "I came to Switzerland motivated by an intense passion for science and because there was no doctoral program in my area of research in Colombia". "After finishing my doctorate I wanted to come to Zurich. The Swiss Federal Institute of Technology in Zurich (ETHZ) is internationally recognized for its Nobel prizes".

For the Colombians and South Africans the feeling of insecurity because of the violence caused by social and political conflicts as well as the scarcity opportunities in their countries of origin was an important push factor. Specifically, the testimonies of the South Africans show us that social fragmentation led to emigration. One engineer/businessman said that he left the country because of the problems of apartheid, *"where the unequal distribution of resources for education went against*

*me*". Another engineer said that his concerns were similar to those of many of his family members and colleagues in the 1990s, faced with a growing atmosphere of affirmative action "where I could not clearly see my opportunities to position myself in the future".

As far as the sources of information that stimulate the motivation to emigrate are concerned, we see that relations, friends and colleagues who are established in the host country are those who provide information on opportunities for scholarships and grants within the framework of bilateral scientific cooperation, exchange programs, or opportunities in the labour market. In this respect, we can observe that scientific links, professional networks and social contacts have a significant influence on international mobility. Another major motivation is the very vigour of scientists and skilled professionals themselves as they search for opportunities to access more fertile scientific or professional environments. One Indian doctoral student said: "I was working on a project in India, and while looking for publications, I found the name and the institute of the person who is now my supervisor. He is one of the main scientists in my area, so I contacted him".

We can observe that the bilateral collaboration programs, such as the Indo-Swiss Collaboration in Biotechnology (ISCB) Program, are usually facilitators of scientific and student mobility. One postdoctoral researcher in microbiology from India mentioned this: "I received finance from the ISCB to do a stage in Switzerland with a good salary and as part of an interesting work group".

*Social capital, integration and collective action*

Esman (1986) considers that the resources –material, cultural and organizational- that the diasporas have are essential in terms of motivating interactions among their members and for driving collective action. In a similar way, Bruggeman (2008) points out that an organization is based on a purpose community and can be defined as a network of people spending part of their time to strengthening relations among themselves and with the environment, based on a community proposal.

The organizations and collective actions of the members of the scientific diasporas are significant as they offer access to an important social capital (Bourdieu, 1986) through their implementation and operation as a result of the contacts, social and professional links and the institutional relationships that are established. For Bruggeman (2008), the social capital represents the benefits of the interpersonal links of social networks. In order to be able to explain how these benefits are obtained, Bruggeman says that we need to consider some fundamental elements such as cohesion, social support or the environment, as determinants in the creation of contacts and social networks. In the country of destination, institutional relations and contacts and social and professional links influence the status of the scientists and skilled professionals by giving them sustained access to valuable social resources, thereby facilitating their integration, both socially and in the labour market. Accordingly, social networks facilitate social recognition and integration, and as Riaño and Baghdadi (2007) point out, this gives access to a better class status.

We can see that the organized initiatives of the scientific diasporas are stimulated by a sense of community, which reinforces their mobilization skills and their collective actions, and encourages their participation in associations. As Bruggeman (2008) says, the propensity of individuals for sociability means that they prefer to join others in groups and communities of various types, and to develop the capacity to mutually support themselves collectively. Indeed, their participation in associations plays a decisive role in this process by facilitating access to social resources and their integration in the host country. However, when they move to a new country, emigrated scientists do not abandon what they have left behind, and indeed on the contrary, they stimulate their contacts with their country of origin. Their transnational practices allow them to satisfy their dual objectives of preserving their identity linked to their country of origin while simultaneously integrating into the country of destination (Faist, 2000, 2010).

We can see that scientists and skilled professionals from Colombia, India and South Africa develop scientific and professional links at a local and international level through their affiliation in various types of

networks and associations. In the Colombian case, scientists and skilled professionals established in Swiss academic and research institutions founded the Association of Colombian Researchers in Switzerland (ACIS) as a platform for exchanges that promote scientific collaboration with Colombia. The functioning of the ACIS is based on an intensive use of information and communication technologies as a tool for the transfer of knowledge, and on the trend towards a decentralization of knowledge production. The social network derived from the ACIS has created a corridor of doctoral students and researchers as well as an important body of contacts that feeds off the exchanges among its members, and which offers a social capital of great value which the Colombians can access, thereby providing them with their first experiences in the country of destination. A member of ACIS referred to the advantages apart from the professional links that are developed through ACIS: "the association has also managed to establish strong bonds of affinity and friendship among its members." Another Colombian member and researcher pointed out: "ACIS is a very powerful mechanism for communication and information, linking and exchanges. It strengthens capacities and it contributes to identifying collaboration opportunities".

Also, in the case of India, the associations directed towards the country of origin have proved to be useful in terms of establishing social and professional contacts and creating links. Furthermore, we can observe a feeling of community shared by the majority of Indian scientists and skilled professionals that transcends ethnic, social, linguistic, religious and cultural diversity through associative activities. The testimony of a member of the Indian Association in Geneva shows that through the associative activities "*one seeks to stimulate contacts and offer opportunities to socialize*", and an attempt is made to promote the culture of India among the second generations so as "to keep young people involved and to prevent them from losing the link with their place or origin".

However, this not valid in the case of the South Africans, whose mobilization and collective association skills are not apparent mainly because of the absence of a shared identity or a feeling of community as a result of the social and cultural fractures of the recent history of South Africa, which have been transferred to the diaspora

(Kwankam, 2010). One South African student commented: "Unlike other groups, South Africans do not associate simply on the grounds of their common nationality".

We can see especially in the South African case that the interest and feeling of belonging to the country of origin varied considerably depending on the determinants for emigration and their links with South Africa. One South African lecturer said that South Africans are very divided and that *"many emigrated because they did not accept the changes that took place at the end of apartheid"*. One student said: "We South Africans are very different. It is especially difficult for a mixed-race person because the diaspora is white or black and the racial tensions of the past are still to be felt".

We saw that for scientists and skilled professionals from Colombia, India and South Africa, social integration in Switzerland depends on a range of factors, including social relations and networks and friendships, labour market opportunities, the power to communicate with the local community and to participate in public events or in local associative activities. The empirical evidence that we found suggests that institutional relations, social contacts and scientific links are essential with regard to reinforcing the social capital of scientists and skilled professionals from Colombia, India and South Africa in Switzerland, and with it their class position. This, in turn, facilitates their integration into the job market and the social life and boosts their transnational initiatives.

The evidence also shows that the links and transnational practices coexist with the desire of the scientists and skilled professionals to adapt and integrate into the country of destination, and this shows that integration and transnational practices, which at first seemed opposed or contradictory objectives, are in practice complementary objectives, being two elements of a logic duality, which is translated into the interest migrants have to participate actively in the society that hosts them and at the same time to preserve the cultural identity that identifies them. One Colombian lecturer mentioned that obtaining the citizenship of the country of destination stimulates his feeling of integration, but only partially, as he continues to feel Colombian in other aspects. He refers to his dual identity in the following way: "I feel partially integrated. I

acquired Swiss citizenship and I participate in the society through my job and the university and my research. However, in the everyday aspects of my private life and in culture, I continue to be a Colombian. I have maintained a dual position".

One South African businessman and researcher referred to this dual feeling of belonging, saying: "I have transnational interests and thoughts: I have my feet here when I am here but I also feel part of South Africa and as if I was there every day".

*Examples of collective actions*[9]

The experiences of the scientists and skilled professionals from Colombia, India and South Africa in Switzerland show determinants that allow the initiatives to materialize in specific projects that have the potential to promote the progress of the countries of origin. We can see that the members of the scientific diasporas make use of the ICTs through decentralized and collective actions that are fundamental in terms of reinforcing their capacity to create an influence in the country of origin.

An interesting example is the aforementioned Association of Colombian Researchers in Switzerland (ACIS)[10] which was created in 1992 by a group of Colombian researchers involved in academic and research activities in different areas with the aim of promoting the advancement of science and technology in Colombia through the exchange and transfer of knowledge. We can see here how the members of the scientific diasporas act in an organized way, forming associations that work as collective spaces to promote the exchange and circulation of the knowledge that they produce.

The purpose is to make knowledge available to the public and to encourage its reproduction and circulation. Through this experience, we can see how the scientific diasporas assume a relevant role in the process of decentralizing world knowledge. One of the Colombian scientists

9. Tejada and Wickramasekara (2010) suggest a specific methodology to evaluate the decentralized and collective actions of scientific diasporas and they offer specific examples of good practices.
10. http://www.acis.ch

who helped found the ACIS referred to the way that it operates: "To reach its objectives, the association promotes the implementation of research projects in collaboration with Colombian institutions".

ACIS has been a pioneer in the use of ICTs as a tool for collective action, and in its day it benefitted from favourable conditions and from an atmosphere of trust for the circulation of knowledge, thanks to the support of Colombian public institutions. Indeed, in the 1990s, ACIS operated as the Swiss node of the Caldas Network of Colombian Scientists Abroad[11].

The association is a paradigmatic case of the establishment of a collective space which has impacted science in the country of origin through the creation and strengthening of a critical mass in key areas for the development of Colombia, such as environment and natural resources, information and communication technologies and medicine, through systematic scientific collaborations carried out over the last two decades. With the example of ACIS we can see that when the members of the knowledge communities act as a group and develop their skills in an organized manner, they facilitate collective influence in the country of origin and they become agents of change.

The experience of ACIS shows that both a community identity and intensive mobilization stimulate participation and actions from a distance which benefit the country of origin. However, the lack of systematic financial and institutional support has limited the scope and the durability of its operations and this has created scepticism among its members and resulted in grim perspectives with regard to institutional commitment in Colombia. One Colombian scientist said that the value of the resources accumulated in the ACIS "i*s a goldmine which Colombia has not known how to harness*". Another scientist said that insufficient institutional support from the government *"is explained by the fact that scientific research is not currently a priority for Colombia*".

11. As a knowledge community the Caldas Network is an interesting example of institutional intervention which, even though it strengthened the operationalization of the Colombian scientific diaspora, also obstructed the capacity to host projects in the country of origin, thereby provoking its failure (Tejada, 2010).

Another relevant example is the creation of the KIIT School of Biotechnology at the University of Orissa[12] by a researcher from India who returned to his country after doing postdoctoral research for three years at the ETHZ Institute of Macrobiology. The multiple capacities for the creation and reproduction of the knowledge are manifested here through a combination of personal motivation and adequate institutional support. In this case, the objective of the expansion of education in biotechnology is attained through the creation of links of trust with institutions in Switzerland and India and with Nobel Prize winning scientists. The researcher and founder of the school mentioned that he received an offer to create the institute and that his task was centred on the establishment of contacts and the identification of human capital for it: "I am choosing suitable persons and establishing academic and institutional strategic contacts to attract knowledge and talent back to India." We can see that his strategy considers the return of the human capital to the country of origin: "I have met Indian talented scientists in Germany and Switzerland who I want to contract". With regard to strategic contacts he said: "A Nobel laureate participated in the foundation of the institute".

The objective of the school is to offer international-standard training to MA students in biotechnology and to strengthen local scientific and technological capacities in the state of Orissa. The members and the scientific committee of the school include local scientists and researchers, as well as members of the scientific diaspora from India living in different European countries, who keep in touch through ICTs and temporary returns to the homeland.

This project facilitates the decentralization of knowledge production and it increases the number of users and involves more people in the scientific production processes within a key area for the development of India – biotechnology - which is considered to be one of the least favoured areas on the research scene in this country. The establishment of a network of strategic contacts in the country of destination was a determining factor for the success of this initiative together with the receptiveness of the institutions in India, which gave it support and helped to create a climate of trust.

12. http://www.kiitbiotech.ac.in/

The third significant example is the cooperation program within the environmental area between the École Polytechnique Fédérale de Lausanne (EPFL) and several Colombian institutions. Its creation was the result of an initiative from Colombian scientists at the EPFL who were interested in promoting research within the environmental area in Colombia, and stimulating the creation and reinforcement of scientific capacities through student and researcher exchanges. The aim of the program is to contribute to the resolution of Colombia's environmental problems and it includes specific applications for social development in areas such as water diagnostics, soil and air pollution and geographical information systems.

The program started off as a research project between the EPFL and the Universidad del Valle in 1994, and since then it has promoted the implementation of other projects in similar areas. Since its creation, it has facilitated dozens of doctoral and postdoctoral studies, Master's and undergraduate diplomas, training courses, as well as the publication of numerous scientific articles in specialist journals and communications at international congresses. Furthermore, the program has encouraged Colombian students and researchers who have spent stages in Switzerland to return to Colombia. As a result, it has contributed to the creation of a critical mass in Colombia and both individual and institutional capacities have been strengthened. The program has also contributed to the design and implementation of public policies related to environmental challenges.

The success of this practice has been the great motivation of Colombian researchers in Switzerland, and the possibility of developing their skills in an organized way based on a favourable institutional framework which has facilitated collective influence over the years. Some of the main obstacles encountered by the program have been the lack of systematic financial support for Colombian universities and the reduction in support from the Colombian institutions in charge of science and technology for the training of Colombians abroad.

One Colombian scientist, who has been the driving force behind this collaboration, ensured that for scientific cooperation with the country of origin "it is important to establish collaborations that act as bridges

by including partners at the highest level to create influence". He also mentioned the need to "strengthen existing institutional and human resources and to open spaces and share contacts in order to facilitate exchanges and create a basis for mutual trust."

These examples[13] show us the relevance of the collective action of the scientists and skilled professionals, who through their participation in associations, organizations and networks, and motivated by their collective identity and the interest to promote their leading role in the production of world knowledge, jointly develop their social capital for the benefit of their countries of origin.

There are experiences of other geographical contexts that have operated in a similar way. For example, India and China are relevant cases since during the decade of the 1990s professionals and technical personnel from these countries mobilized their fellow nationals through the creation of associations and networks in the region of Silicon Valley in the United States, creating collaborations from a distance with their countries of origin which encouraged relations of undertaking that influenced their technological competitiveness (Saxenian, 2006). Another interesting experience is that of Rumania and the creation of the Ad-Astra Network, which is an example of an alternative to the retention and return schemes given priority by the countries of Eastern Europe that goes for the scientific diaspora option. This case shows how a small but very active group of Rumanian scientists in different countries of destination mobilized themselves to act in favour of the reform of the research sector in Rumania, showing how their common scientific vocation was articulated towards civil action in a collective way (Nedelcu, 2008).

13. Annex 1 lists additional examples of transnational practices that have come to light during our research.

TABLE 1
Examples of transnational practices benefitting the country of origin

| NAME OF THE PROJECT | COUNTRY OF ORIGIN | DESCRIPTION | IMPACT |
|---|---|---|---|
| Establishment of the South African Centre for Epidemiological Modelling and Analysis (SACEMA), and the African Institute for Mathematical Sciences. | South Africa | Research centre which promotes research in mathematics and epidemiology as well as the application of mathematics in matters related to public health. | Development and/or strengthening of individual and institutional capacities; influence in the design of public health policies; contribution to the resolution of local problems related to public health. |
| Bilateral Agreement in Science and Technology between the South African Department of Science and Technology and the Swiss Ministry of Education and Research. | South Africa | The agreement has the objective of increasing bilateral scientific and technological interaction, cooperation projects and exchanges in areas related to public health and biomedicine, biotechnology, nanotechnology and human and social sciences. | Implementation of scientific and technological cooperation projects in matters of strategic relevance for local development. |
| Creation of the School of Biotechnology at the University of Ori | India | The objective of the School is to provide knowledge and capacities in biotechnology to Masters students in accordance with international standards. | Development and/or strengthening of local individual and institutional capacities in the area of biotechnology and microbiology; promoting the return of human capital to the country of origin; creation of employment; contribution to the creation of a critical mass in priority areas for development. |
| Creation of the Association of Colombian Researchers in Switzerland (ACIS). | Colombia | Association of Colombian scientists which facilitates and encourages exchanges with Colombia, and promotes activities related to the scientific and technological development of Colombia. | Potential impact on science and technology in Colombia, and on the development and/or strengthening of local individual and institutional capacities through education and training, the influence in public policies, and scientific exchanges in priority areas for development. |
| Establishment of the Cooperation Program in the environmental area between EPFL and Universidad del Valle. | Colombia | Cooperation Program which seeks to contribute to the resolution of environmental problems in Colombia through the launch of scientific cooperation projects between the EPFL and Colombian institutions. | Creation of a critical mass in key areas for development; strengthening of the scientific capacities of Colombian institutions and researchers through training courses, exchanges and research. |
| Various philanthropic activities. | Colombia, India and South Africa. | Donations to orphanages, various philanthropic activities and support for social organizations. | Contributes to the reduction of poverty in underprivileged social sectors. |

Source: Based on information obtained during research into scientific diasporas in Switzerland (2007-2008)

*Challenges for the implementation of contributions from a distance*

In examining contributions from a distance we can see that their transcendence and level of influence do not correspond to the level of motivation and the efforts that their implementation implies. We can see, especially in the Colombian case, that motivation and affective capital (Tejada, 2007) together with the feeling of belonging and the links to the country of origin greatly exceed the scope and the weight of the actions from a distance. Even though they are collective actions, many of these initiatives are fragile and their permanence is not assured over time if they do not have systematic institutional backing. Moreover, while a suitable level of infrastructure is necessary, it is also essential for there to be an interest in the country of origin to host the initiatives of the diasporas. One Colombian scientist referred to these difficulties when he said: "The initiatives in favour of Colombia require constancy and perseverance. The concept of collaboration implies the agreement of the parts to execute a project together, but in general it does not work this way, and not all of them are interested in investing resources and seeing these initiatives carried through."

As Wickramasekara (2010) states, the euphoria with regard to recognizing the potential of diasporas should be distinguished from the real scope of the contributions. Although there is a broad consensus with regard to the value of their resources, there is no guarantee that their projects benefiting the country of origin will become relevant. In this respect, we can see that the public policies of support both in the country of origin and in the country of destination are perceived by scientists and skilled professionals as essential in terms of giving systematic back up to their transnational initiatives and increasing the level of impact. One Colombian lecturer put it this way: "The diasporas in themselves cannot do much without the active participation of governments. The diasporas contribute with the human element "here", but the human element "there" is essential. We have had some success but there is no continuity. The diasporas are the point of departure, but they do not represent anything in themselves".

We can also see the danger of an imbalance in the sectorial support of institutions. Some scientists and skilled professionals from India expressed concern about the unequal support between areas and

sectors in the country of origin. One researcher said: "The best people go to the sector of information and communication technologies because it pays better; other areas of research that are important for India are being ignored".

Even though the motivation of the scientific diasporas to participate in collective actions is palpable, the environment is of crucial importance in the continuity of their organization and collective action and in the possibilities of having an impact (Bruggeman, 2008) (Brinkerhoff, 2006). As Westcott and Brinkerhoff (2006) point out, both the motivation to act collectively and a suitable environment are necessary factors in order for diasporas to function as agents of change.

## CONCLUSIONS

The importance of science and the production of knowledge for the development of countries cannot be called into question. Within a context in which knowledge-based economies acquire relevance, it is essential to reflect on how to optimize international cooperation for circulation and the world exchange of knowledge that benefits developing countries. International cooperation should be understood as a system in which the opening up of knowledge that is based on the dissemination and exchange of new knowledge is carried out in an effective and systematic way. In this context, it is important to consider the influence of the international mobility of scientists and skilled professionals since scientific diasporas, as communities of knowledge, participate in the production of knowledge and they seek to stimulate the impulse given to research and strengthen the critical mass in the country of origin through multiple forms of collaboration. At the present time, scientific diasporas are valuable actors that innovatively intervene in the process to exploit the benefits of knowledge through the creation of organization systems and through collective action. Various elements intervene in the process for developing the mobilization capacity of the diasporas and the setting up of their initiatives. The ICTs are tools that play a significant role in stimulating the power to produce and circulate knowledge and to encourage organized action.

The study of scientists and skilled professionals from Colombia, India and South Africa living in Switzerland shows that the practices and activities of scientific diasporas of these countries outline an international deterritorialized space and it highlights the value of their decentralized mechanisms in favour of the countries of origin. It was observed that the social capital and the various mechanisms for exchange, reciprocity and solidarity, that are typical of transnational communities, facilitate access to other important social resources, which are crystallized in cooperation networks and associations. We can see that identification with the country of origin - even though it does facilitate collective action - does not necessarily result in a channel of contacts or systematic exchanges with the homeland. The empirical evidence shows that in order for the transnational initiatives of the scientific diasporas to have a greater possibility of being materialized in specific collaboration projects, it is necessary for the personal motivation of the scientists and skilled professionals to be associated with organized practices and to be supported by suitable institutional backing in the countries of destination as well as in the countries of origin. We can see that the *bottom-up initiatives* of the members of the scientific diasporas are usually fragile and they require institutional responses that support them so that they can be carried out in specific projects.

The good practices presented here are examples of the multiple capacities for the creation and reproduction of knowledge of scientists and skilled professionals who live outside their countries of origin. They are proof that the success of the transnational practices of the scientific diasporas requires the establishment of organized actions that facilitate collective influence. Furthermore, as new relevant actors in knowledge economies, scientific diasporas need opportunity structures that allow them to act as agents of change.

Finally, as we have argued in this article, the option of contributing *from a distance* must continue to be considered as a promising alternative to the retention and return of human capital, allowing the countries to benefit from cooperation with the emigrated scientists and skilled professionals. One Colombian scientist said: "It is good for Colombia that not everybody goes back. I feel that I can help more from here,

acting as a bridge and connecting people in Switzerland with those in Colombia, and encouraging them to carry out science and to do research to help the transfer of knowledge"

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